Understanding the Risk of Bat-Borne Zoonotic Disease Emergence in Western Asia

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Royal Scientific Society

EcoHealth Alliance

NCDC

Technical Description and Background

Technical Description

Characterize the diversity of bat-borne coronaviruses (CoVs) in Western Asia.

Combine host (bat), viral, and ecological data to better understand the risk factors to **reduce the risk threat of CoV emergence in the region**.

Promote multi-disciplinary scientific collaboration and training opportunities to improve preparedness for zoonotic virus emergence.

Current Understanding

- Bats are known to harbor zoonotic viral threats worldwide
- Coronaviruses of bat origin are of particular concern for human and livestock health (SARS, MERS, SADS)
- Virtually nothing is known about viruses in natural bat populations from Western Asia.
- More effort needed to strengthen zoonotic disease surveillance, risk assessment, and information sharing in the region

Threat Reduction Objectives

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1. Enhance understanding of endemic coronaviruses to allow differentiation of natural vs. nefarious emergence events in the future

2. Support biosurveillance capacity building by enhancing partner capabilities to detect, diagnose, and report select agents

3. Engage partner country scientists in high-quality, hypothesis-driven research to elucidate the risk factors associated with bat-borne regional disease emergence

4. Employ responsible bio-risk management best practices to strengthen biosafety capacity in the region

5. Create and foster a regional network of researchers (WAB-Net), designed to increase communication and collaboration between bat biologists, virologists, and public health officials.

Key Partners and Regions of Study

Key Partners

- **Royal Scientific Society (RSS)** – *Jordan* – Regional laboratory for pathogen characterization; field data collection
- **R. Lugar Center, NCDC** – *Georgia* – Regional laboratory for leading pathogen characterization; field data collection
- **Boğaziçi University** – *Turkey* – 'High-Engagement' country partner, field data collection
- **University of Veterinary & Animal Sciences (UVAS)** – *Pakistan* – 'High-Engagement' country partner, field data collection
- **Yerevan University; Armenian Association of Mammologists** – Armenia – *'Medium-Engagement'* country partner; field data

Regions

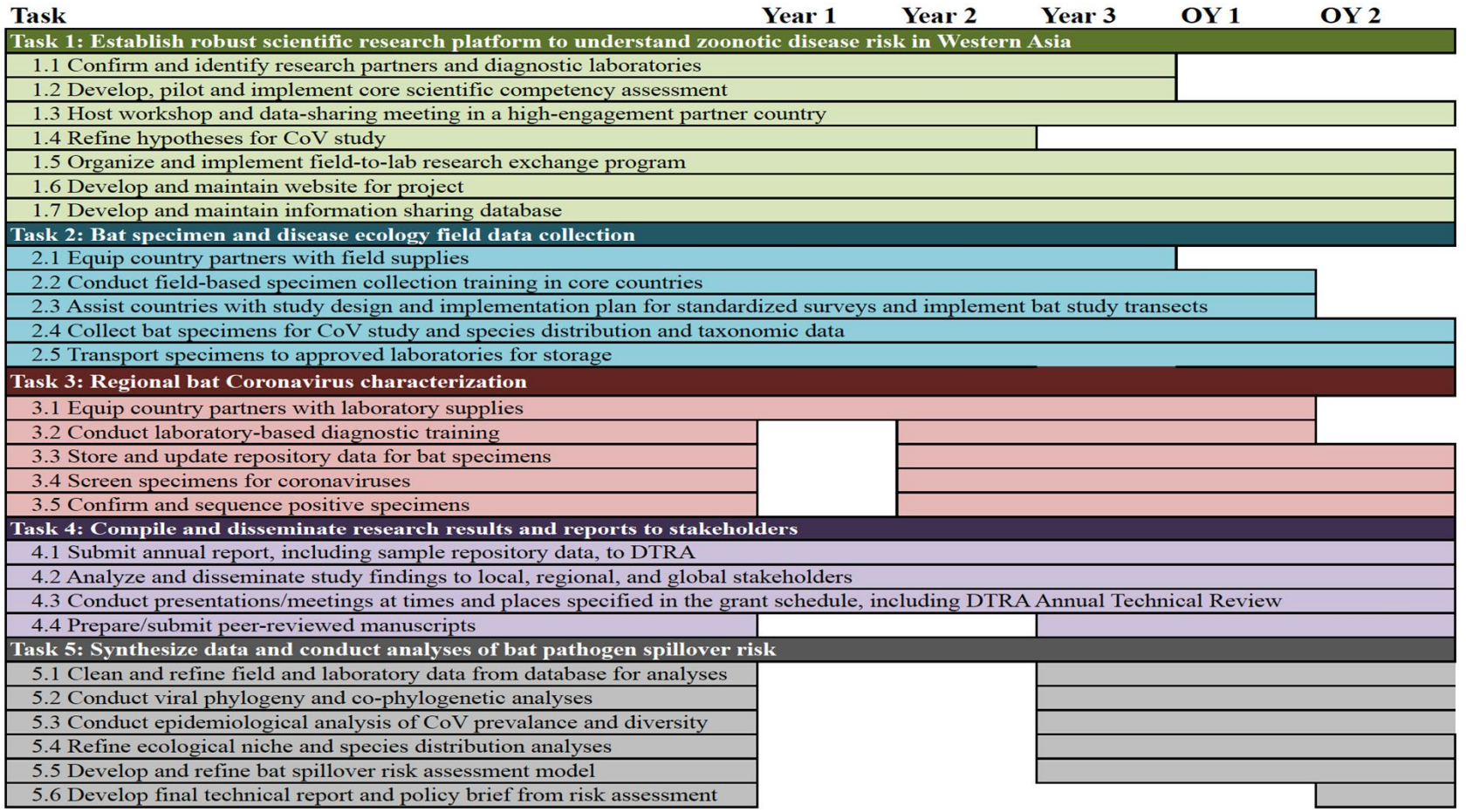
- **EUCOM** (Armenia, Azerbaijan, Georgia, Israel, Turkey)
- **CENTCOM** (Afghanistan, Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Pakistan, Qatar, Saudi Arabia, UAE)

Networks

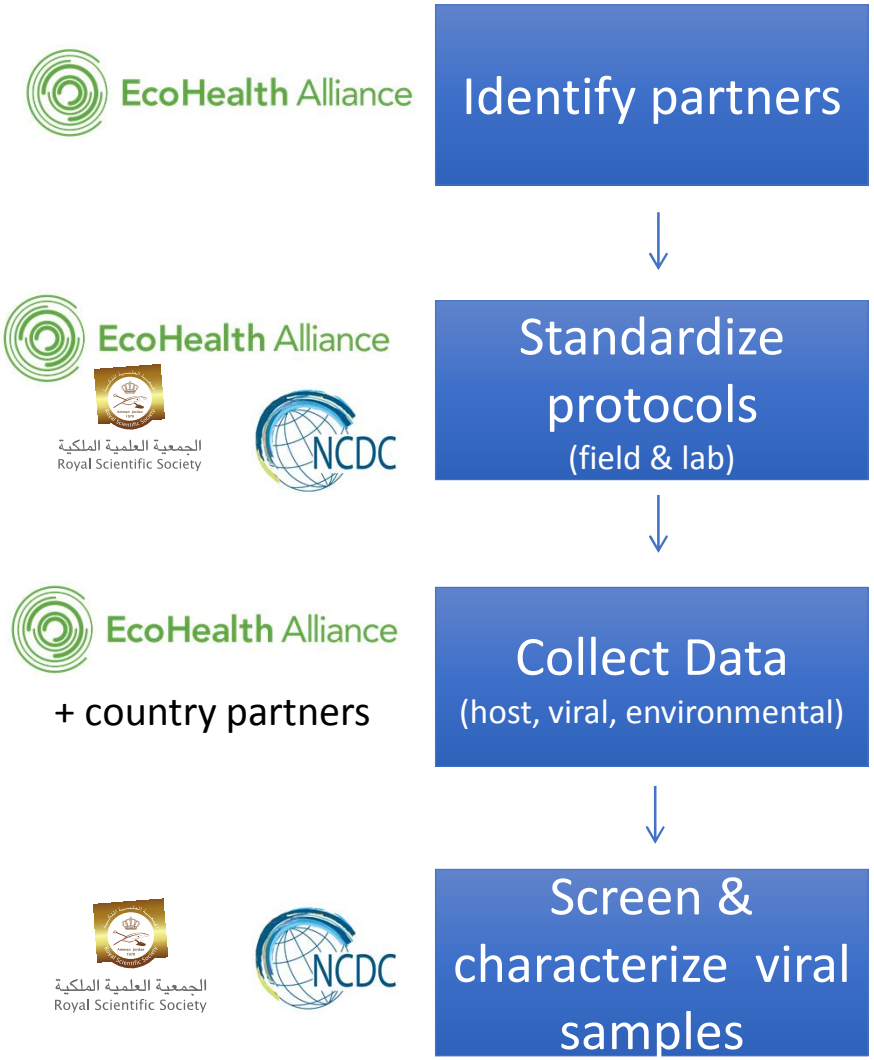
- **Western Asia Bat Research Network (WAB-Net)** Founding and strengthening this network as part of project
- **Bat One Health Research Network (BOHRN)** Co-hosted a joint workshop in Tbilisi, Georgia in September 2018
- **Southeast Asia Bat Conservation Research Unit (SEABCRU)** Active members – Drs. Kevin Olival and Kendra Phelps of EHA; and Dr. Tigga Kingston SEABCRU founder is member of WAB-Net SAB
- **EUROBATS** Dr. Paul Racey, is founding member and *on* WAB-Net SAB
- **PREDICT** – Informal partnership with USAID's wildlife surveillance program; and comparison of CoV data, esp. w Jordan

Timeline and Major Milestones

PERFORMANCE SCHEDULE.

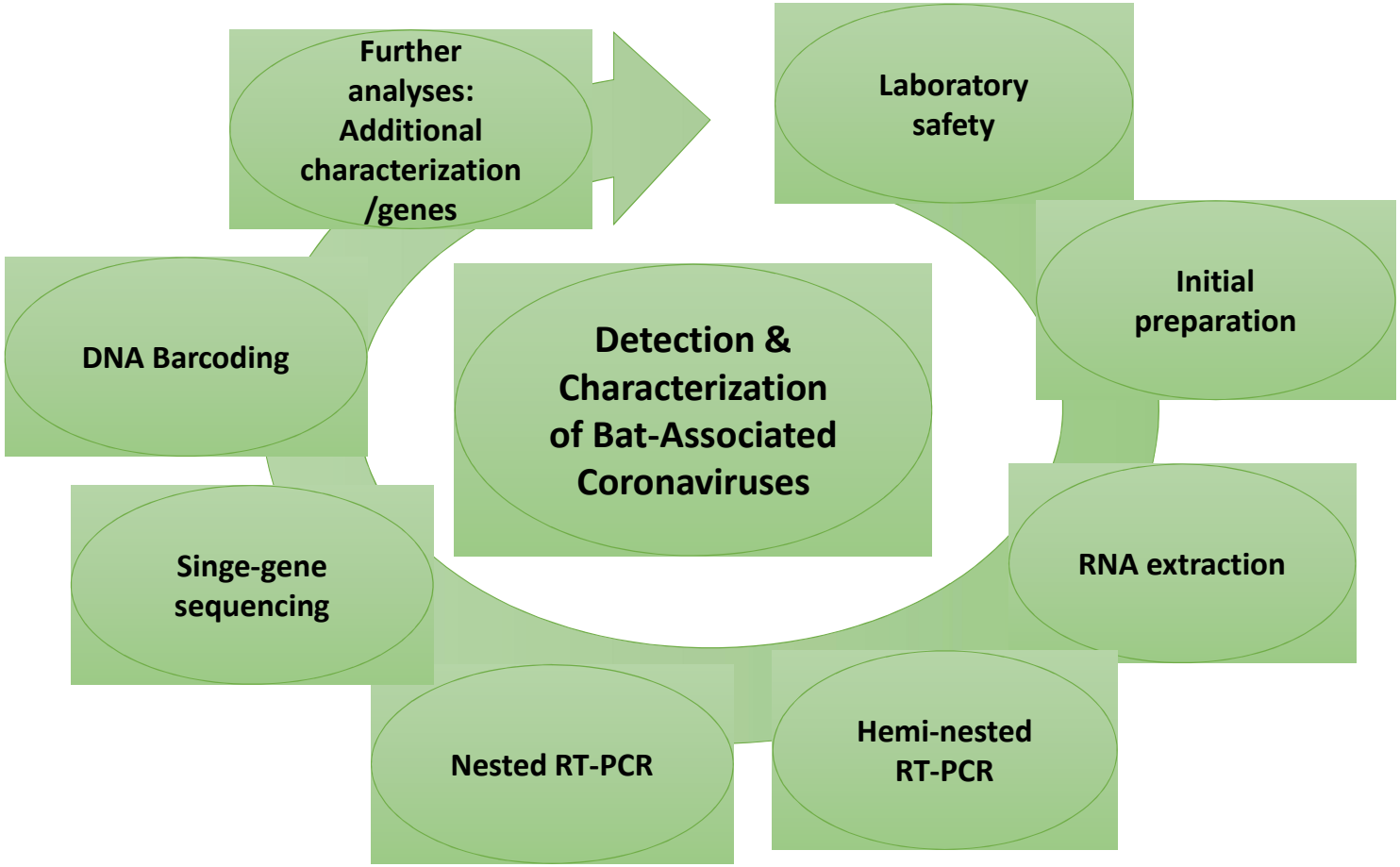


Methods Overview



1) Identify partners:
   - Identify key institutions/personnel, establish Scopes of Work (SOW) and subaward budgets
2) Standardize protocols:
   - Ensure region-wide consistency in field & lab methods
3) Collect data:
   - Ensure biosafety/biosecurity (vaccinations, PPE, proper disposal of biohazards, cold-chain transport of samples)
4) Screen & characterize viral samples:
   - Store samples in -80C freezers prior to lab analysis at BSL-2 laboratories, screening and characterization of CoVs, host DNA barcoding, safely store aliquot for further characterization
5) Upload data:
   - Upload field and lab data to password-protected database
6) Assess disease emergence risk:
   - Assess spillover risk using host, viral, and environmental data and spatial hotspot models

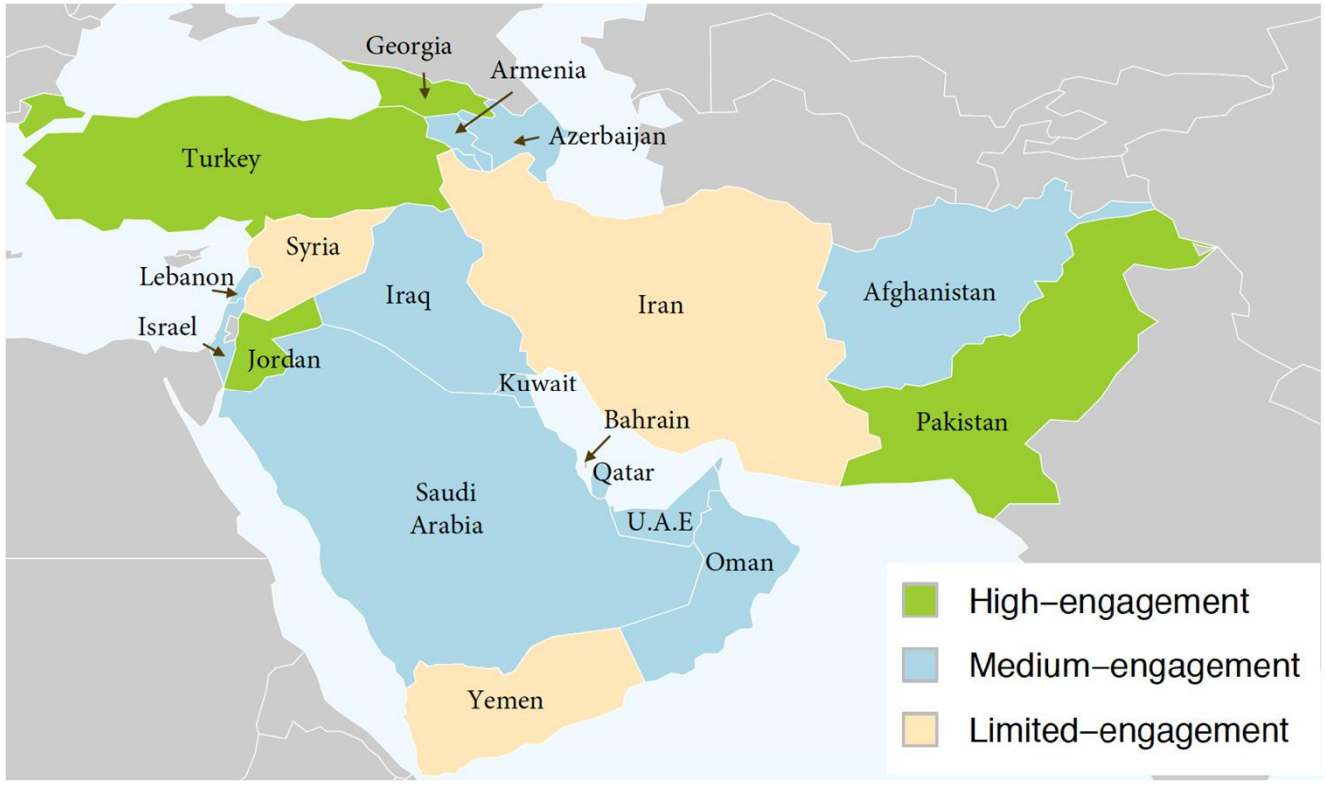
Laboratory Methods



Results

Quantitative Results

- **Identified key personnel,, partner organizations,** and **sampling sites** in **7 countries in Western Asia**
  - Georgia, Jordan, Pakistan, Turkey, Armenia, Azerbaijan, Oman



Results (cont.)

- **Trained over 25 regional scientists** in best practices of non-lethal bat capture, viral sampling, biosafety and cold-chain specimen transport and storage

Results (cont.)

- Collected and stored **2,700 clinical samples from free-ranging bats**
- **Over 450 individual bats (of 17 species)** in **4 WAB-Net partner countries**: Turkey, Georgia, Jordan, Armenia

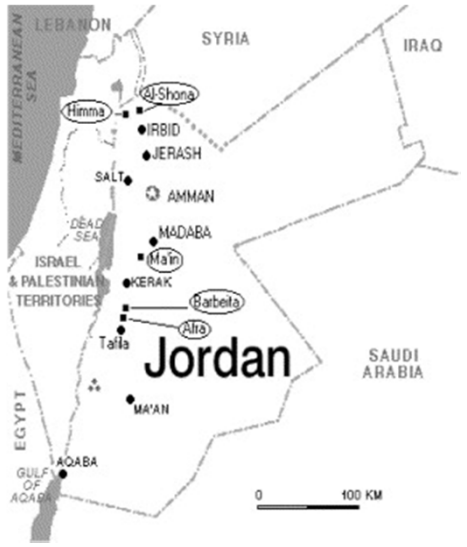
WAB-Net Partner Country	Turkey	Georgia	Jordan	Georgia	Armenia
Sampling Dates	21-25 Aug 2018	10-13 Sept 2018	4-7 Oct 2018	7-11 Jun 2019	12-16 Jun 2019
Species (no. sampled/site)	Cilingoz Cave	Ghliana Cave	Pella Cave	Letsurtsume Cave	Areni 1 Cave
Barbastella capsica	0	0	0	0	32
Eptesicus serotinus	0	0	0	0	20
Hypsugo savii	0	0	0	0	1
Miniopterus schreibersii	30	78	0	9	0
Myotis capaccinii	15	0	0	0	0
Myotis blythii	0	8	0	7	20
Myotis davidii/aurascens	0	0	0	1	0
Myotis emarginatus	0	0	0	11	1
Myotis tschuliensis	0	0	0	0	2
Pipistrellus pipistrellus	0	0	0	0	11
Rhinolophus blasii	17	1	0	0	0
Rhinolophus euryale	27	2	0	58	0
Rhinolophus ferrumequinum	1	1	0	3	3
Rhinolophus hipposideros	0	0	0	1	0
Rhinopoma cystops	0	0	2	0	0
Rhinopoma microphyllum	0	0	60	0	0
Rousettus aegyptiacus	0	0	28	0	0
Total Samples/Sites	**90**	**90**	**90**	**90**	**90**

Results (cont.)-Jordan

Year 1

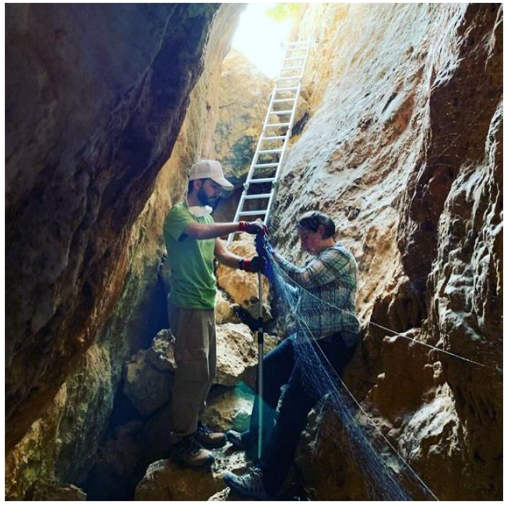
- One sampling trip (October 2018)
  - Pella Cave
- Bat species:
  - Rhinopoma microphyllum
  - Rhinopoma cystopes
  - Rousettus aegyptiacus

Results (cont.)-Jordan



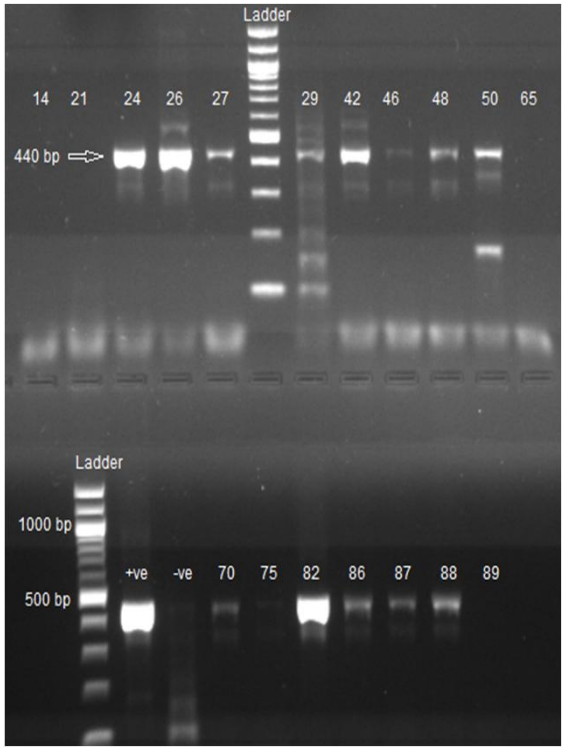
Year 2

- First sampling trip (July 2019)
  - Al-Himma cave (Irbid)
- Second sampling trip (August 2019)
  - Baoun Canyon (Ajloun)
- Bat species:
  - Rhinolophus ferrumequinum
  - Rhinolophus euryale
  - Rhinopoma microphyllum
  - Rhinopoma cystopes
  - Rousettus aegyptiacus

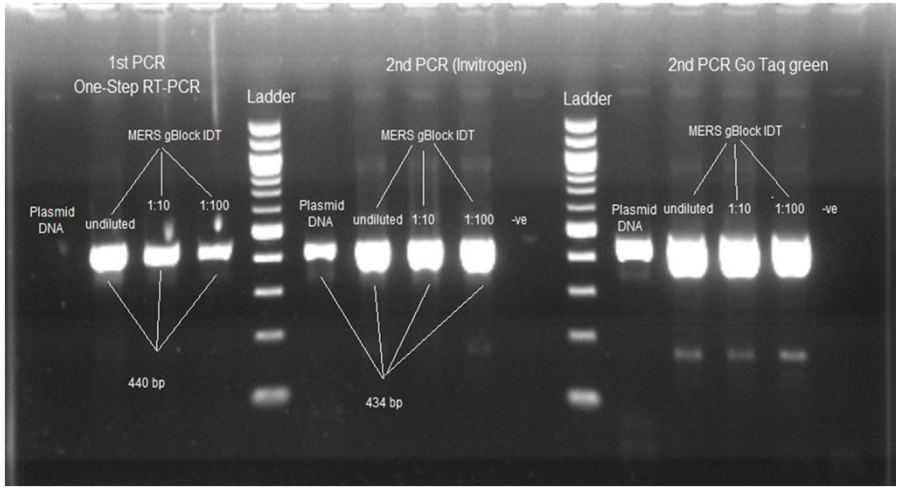


Results (cont.)-Jordan: ***Lab Results for Year 1 Samples***

- A total of 90 fecal samples collected in TRIzol reagents were analyzed against Coronaviruses.
- More than 60 samples were *presumptive* positive by Pan Coronavirus PCR assay.
- Samples were sent for sequencing to confirm the results and identify the Coronavirus strains.



Lab Protocol and PCR Optimization



Results Year 1- Georgia

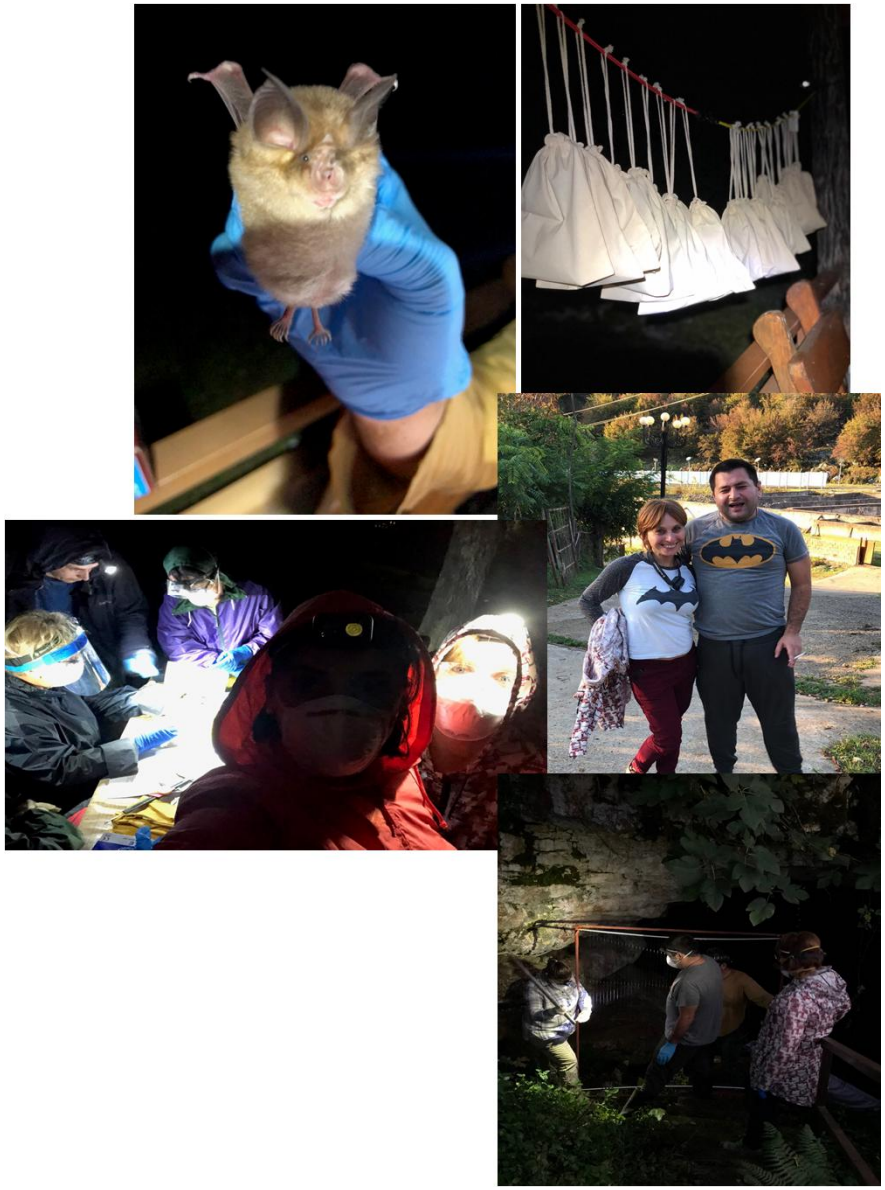
Year 1

- First sampling trainning/trip
- Gliana Cave
- Bat species:
  - Miniopterus shreibersii
  - Myotis blythii
  - Rhinolophus euryale
  - Rhinolophus blasii
  - Rhinolophus Fenemaquinum
  - Hippoisideros euryale

Results Year 2- Georgia

Year 2

- First sampling trip (June 2019)
  - Letsurtsume cave
- Second sampling trip (August 2019)
- Tetri Senakebi
- Third sampling trip (September 2019)
  - Samertskhle klde
- Bat species:
  - Myotis emarginatus
  - Rhinolophus euryale
  - Rhinolophus hipposideros
  - Rhinolophus ferrumequinum
  - Rousettus aegyptiacus
  - Miniopterus shreibersii
  - Myotis blythii



Results - Georgia

- Totally 360 bat samples were collected in Georgia

✓ 720 Fecal swab
✓ 720 Oral swab
✓ 360 Blood samples
✓ 360 wing puch

- 90 Bat samples were reseived from Turkey
- 450 RNAs were extracted from fecal samples obtained in Georgia and Turkey

October LC will receive samples from Azerbaijan and later from Armenia.

Results (cont.)

- Held **inaugural, capacity-building WAB-Net workshop** from **17-20 September 2018** in Tbilisi, Georgia with **40 participants from 11 countries** in Western Asia
- This workshop included a **Biological Threat Characterization Discussion (BTCD)** led by Mr. Lance Brooks and Dr. Marty Stokes of DTRA's Bat One Health Research Network (BOHRN)

Threat Reduction Impacts

Regional / Country Impact

- **Standardized field and lab protocols** to ensure region-wide consistency in bat surveillance and CoV sampling and screening methods
- **Strengthened One Health approaches to biosurveillance** and **improved biosecurity practices** among W. Asia partner nation scientists and at two regional laboratories

Biological Impacts

- **Will identify new strains** of Coronaviruses
- **Will characterize ecological risk factors** for bat-borne disease spillover and **develop recommendations for risk mitigation**

Non-Scientific Impacts

- Establishment of regional bat/biosurveillance research network (WAB-Net)
- Successful scientific information and data-sharing workshop in Tbilisi, Georgia (in collaboration with BOHRN), with 40 participants representing 11 different countries in Western Asia

Publications and Presentations

- Publication
  - Phelps et al., “Bat Research Networks and Viral Surveillance: Gaps and Opportunities in Western Asia”, *Viruses*, 2019
- Presentations
  - Keynote and research talk at 18th International Bat Research Conference
  - …
- Poster
  - 4th International Southeast Asian Bat Conference (SEABCO), 2018
  - 48th Annual North American Symposium on Bat Research (NASBR), 2018
  - 18th International Bat Research Conference (IBRC), Thailand, 2019

Challenges

Challenges

- *Challenge*: Bat seasonality and scheduling simultaneous work across multiple countries in the region.
  - *Our solution*: Prioritized work in partner nations based on: a) bat activity and b) needs for training, and c) identifying joint training opportunities across borders (e.g. Iraq/Jordan; Georgia/Armenia).
- *Challenge*: Procuring permission for wildlife sampling and export; procuring vaccines and necessary materials and supplies for wildlife capture and sampling.
  - *Our solution*: Leveraged our experienced partners in the region, to jump ahead of potential issues and establish relationships with in-country officials re: our project, to ease any concerns and ensure that everyone involved is fully informed. Most supplies successfully procured in country, EHA obtains items that cannot be procured in-country. Export of some specimens to regional labs already achieved.

Next Steps

Next Steps

- Continue field surveillance in partner countries, to collect additional specimens and host, viral, and environmental data
- Screen for and characterize (sequence) CoVs in regional laboratories using standardized protocols
- Expand the geographic scope of sampling and further develop the biosurveillance capacity of scientific institutions across Western Asia
- Quantify the risk of regional disease emergence, by identifying correlates of CoV diversity and distribution, and characterizing interactions between humans and bats